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NATO Air and Space Power in Counter-IED Operations

A Primer

Joint Air Power Competence Centre

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FROM:

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SUBJECT:

NATO Air and Space Power in Counter-IED Operations – A Primer

DISTRIBUTION:

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In recent years, the use of Improvised Explosive Devices (IEDs) has increasingly become a characteristic of modern conflict. Not only are IEDs capable of inflicting military and civilian casualties at the tactical level, but they also offer those who employ them the prospect of exerting strategic influence on a global scale. Countering the pervasive threat of IEDs is an inherently Joint activity, with Air and Space Power playing a key role in defeating that threat, whether in terms of detecting, neutralising and mitigating IEDs once emplaced, or by attacking the systems and networks that support their production and use.

This Primer is designed to provide the reader with an overview of the generic IED threat to current and future NATO operations, and to summarise the ways and means through which Alliance Air and Space Power can contribute to defeating it. It seeks to emphasise the breadth of Air and Space Power capabilities available, describing how the inherent characteristics of each lend themselves to different aspects of the Counter-IED fight. It identifies that a combination of capabilities, the Education and Training necessary to fully exploit these capabilities, and optimised processes to support their use, are key to success.

We hope that this Primer will contribute to a better understanding of the role of Air and Space Power in countering the generic IED threat, and will serve as an introduction to more detailed exploration of this important subject. We would welcome your comments on the Primer or any of the issues it identifies. Please feel free to contact my Combat Service Support Branch Head, Group Captain Dai John at john@japcc.de or +49 (0) 2824 90 2260.

Dieter Naskrent

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TABLE OF CONTENT

PREFACE

Aim

This publication provides a summary of the NATO Air and Space Power contribution to Counter-Improvised Explosive Device (C-IED) operations.

Purpose

In seeking to draw together into a single document the full extent of NATO's Air and Space (A&S) Power contribution to C-IED operations, this Primer addresses an area that has increasingly come to dominate current operations. It considers the factors influencing the employment of A&S capabilities available to commanders, and summarises the issues associated with their use. While offering contemporary real-world examples, it is intended to be relevant to current and future conflict scenarios where the use of IEDs presents a threat to alliance forces and, therefore, to mission success.

Application

This Primer is designed to provide a readily-accessible reference document for use by those personnel with an interest in, or responsibility for, the application of NATO A&S Power in the C-IED role, both operationally and in Education and Training (E&T) environments. It is not intended to offer authoritative or definitive advice, nor is it a substitute for specialist C-IED regulation, policy or reference documents. Instead, it attempts to provide a point of access into a topic that has in many ways come to dominate contemporary operations, and the guidance, principles and capabilities presented in it reflect, and are broadly consistent with, current NATO thinking. Reference to organisational structures and processes is included in order to demonstrate their importance to C-IED operations rather than as a critique of those structures and processes, and it is acknowledged that they are likely to continue to evolve over time; nevertheless, their importance in facilitating the maximum exploitation of all available capabilities, including those provided by A&S assets, cannot be overstated. It should also be noted that the dynamic nature of C-IED developments results in constant evolution, not only of the processes that support C-IED operations, but also in the terminology used. While this Primer utilises the terminology currently employed when describing, for example, the Key Operational Activities referred to later, this is likely to change on a continuous basis. The underlying principles identified in this Primer are, however, more enduring. The reader is, therefore, invited to focus on the principles themselves, rather than the labels currently attached to them.

Acknowledgements

The JAPCC gratefully acknowledges the enthusiasm, candour and expertise of all those individuals and organisations responding to requests for support in producing this Primer.

Overview

This Primer provides a summary of the principle means whereby NATO C-IED operations are supported by its A&S capabilities. In order to offer a self-contained reference source, it sets out the IED threat as it currently exists, making the point that IED use by adversaries is not necessarily limited to Counter-Insurgency (COIN) operations but may also feature in the full range of conflict scenarios. It goes on to consider the generic characteristics of IEDs and their use by an adversary. In discussing the specifics of the A&S Power contribution, it utilises the existing approach adopted by NATO, using three concurrent strategies and six Key Operational Activities as a structure within which to set the various capabilities brought to bear by A&S Power. The document goes on to consider the contribution made to C-IED effort by E&T, summarises emerging technological trends in the A&S domain, and concludes with a reiteration of the key points emerging from this review.

Chapter I – Introduction: Chapter I introduces the importance of the role played by NATO A&S Power in C-IED operations, and states the aim and scope of the Primer. It assesses the likely enduring and evolving nature of the IED threat, identifying the perceived

benefits to an adversary of IEDs and their potential, as an essentially tactical-level weapon system, to impact at the operational and strategic levels.

Chapter II – Characteristics of IEDs: Chapter II sets out the generic systems and technologies that characterise the design of IEDs, including their categorisation based on mode of initiation and method of deployment. It considers the nature of the likely Tactics, Techniques and Procedures (TTP) of those seeking to use IEDs, and emphasises the agility with which such TTPs can evolve to overcome advances in C-IED capabilities. It identifies the development of simpler IEDs which, through the selective use of materials and a better understanding of C-IED capabilities, are no less of a threat.

Chapter III – Countering the IED Threat: Chapter III identifies C-IED principles and sets out current thinking, before considering how this may support the conduct of C-IED operations. It discusses the relationships that exist between C-IED and COIN operations, and how these relationships influence the role played by A&S Power. It highlights the importance of processes that support C-IED operations, and the need for such processes to be swift and effective, fully understood and properly applied. This Chapter also briefly considers recent developments in NATO's strategic C-IED structures.

Chapter IV – The NATO Air and Space (A&S) Power Contribution to C-IED: This Chapter considers how NATO A&S capabilities can support operations aimed at defeating the device, and attacking and defeating the system.[1] Against each strategy, it sets out the factors and considerations associated with the use of airborne and Space-based Intelligence, Surveillance and Reconnaissance (ISR), Electronic Warfare (EW), Air Mobility, and kinetic and non-kinetic effects. In each of these areas, it highlights the importance of E&T, and again reiterates the critical role played by processes and organisational structures in exploiting fully the available capabilities.

Chapter V – Education and Training (E&T) Considerations: This Chapter describes the way in which the third element of NATO's approach to C-IED effort, E&T, represents both a specific strategy in its own right, and pervades all aspects of C-IED activity via the need to provide appropriate E&T to all those personnel engaged in C-IED. It identifies three discrete training audiences, providing examples of the type of training required, and considers the needs of a fourth, in the form of Host Nation E&T requirements.

Chapter VI – Technological Developments and Future Prospects: This Chapter considers the potential for innovative technological solutions to offer significant improvement in C-IED A&S capability, against a background of the need to gain a better understanding of both existing technological capabilities, and the requirements of particular missions and tasks. It identifies the importance of bringing together current capabilities, and considers the relevance of new technological developments in terms of counter-device efforts to detect and disrupt or destroy emplaced IEDs, and in counter-network operations.

Chapter VII – Points for Consideration: This Chapter takes the form of a summarising conclusion. It brings together the key points identified in the Primer in order to provide an easily-accessible summary of issues, factors and considerations that may be of relevance to readers.

1. The terms 'IED system' and 'IED network' are used synonymously in this Primer.

Air and Space Power plays a key role in C-IED operations.

CHAPTER 1

Introduction

1.1 Background

1.1.1 In recent years, IEDs in their various forms have achieved the status of the preferred weapon of choice for insurgencies in operational theatres as diverse as Iraq and Afghanistan, as well as elsewhere. In many respects they characterise modern asymmetry in conflict scenarios where sovereign states' armed forces, individually or in alliances, confront adversaries unable to compete on equal terms with opponents whose greatly superior mass, technology, training, and overall military effectiveness offer, in conventional terms, decisive advantage.

1.1.2 Air and Space (A&S) Power Roles. A&S Power plays a vital role in C-IED operations. While many of the A&S capabilities fielded by NATO, including ISR, are widely recognised as contributing to the inherently Joint nature of C-IED activity, others – for example the agility and flexibility provided by Air Mobility – make contributions that are less immediately obvious. In order to ensure that A&S Power is making the fullest possible contribution to C-IED operations, it is essential that all those who are in a position to plan, train, command, conduct, analyse or otherwise influence the operational employment of NATO A&S Power have an understanding of the ways in which it can be used as an integral element within Joint, Combined Joint, Coalition, and all other forms of cooperative, collective operations. Equally, those who wish to acquire a better understanding of the potential use of A&S capabilities in the context of C-IED operations are also included in this document's intended readership.

1.2 Aim

This publication provides a summary of the NATO A&S Power contribution to C-IED operations. In doing so it addresses, from an A&S perspective, an area that has increasingly become a dominant feature of contemporary operations, and seeks to describe both the extent and the limitations of current A&S capabilities.

1.3 Scope

The scope of this document concerns the contribution made by NATO A&S Power to C-IED operations. The principles identified in it are not intended to be interpreted as relating to specific operational scenarios; instead they are expressed generically to emphasise their wider applicability. In order to reach as broad a readership as possible, this Primer avoids reference to specific aircraft, sensors, weapons and other systems and equipment. This level of detail is, however, readily available, and can be provided by the JAPCC where appropriate and subject to current release regulations.

1.4 Implications

The implications of a broader understanding of the contribution made by NATO A&S Power to C-IED operations relate fundamentally to its operational application, achieved through the provision of relevant E&T to all those individuals, organisations and other entities with an interest or role to play in delivering NATO A&S Power. In addition to E&T, the major themes identified, in particular the need for agile, responsive supporting processes and the judicious combination of existing intelligence collection and sensing technologies and capabilities, have implications for the planning and execution of operations and in the development of future NATO A&S capabilities and TTPs.

1.5 The IED Threat

The attraction of IEDs to potential adversaries is clear. IEDs are cheap to produce from raw materials and components, including fertilizer-based explosives (generally referred to as Home-Made Explosives (HME)) and commercial detonators, readily available for legitimate purposes and which are often mass-produced. In their various forms, they can both exploit and defeat – sometimes concurrently – well-proven and reliable technologies, such as are used in Electronic Countermeasures (ECM). Furthermore, design developments and details of IED construction are readily obtainable via global communications and IT systems, including the internet.

1.5.1 Tactical Impact. The single greatest attribute of IEDs is, however, their effectiveness. At the tactical level their use, for example in Afghanistan, continues to inflict significant numbers of casualties on Coalition and National Security Forces, as well as among the local civilian population. According to Afghanistan Rights Monitor (ARM), IEDs 'currently kill and injure more civilians than any other fighting tactic,'[1] with predictably devastating effects on close-knit, often rural communities. Between January and June 2010, ARM recorded 282 civilian deaths and 490 injuries, resulting from over 130 IED attacks. In terms of Coalition losses, it has been estimated that since 2003, between 70–90% of overall military casualties in Afghanistan have been inflicted by IEDs, with 279 ISAF and 564 Afghan National

IED use can inflict significant casualties on Coalition and National Security Forces.

In Afghanistan, IEDs continue to pose a threat to local populations.

Security Forces (ANSF) personnel killed in 2009. Between January and July 2010, 185 Coalition soldiers had been killed by IEDs. As a result, insurgents have constrained Coalition Forces' Freedom of Manoeuvre (FoM), affecting their ability to engage with civilians, an aspect of their role regarded by senior commanders as critical to the success of ongoing COIN operations.[2] At the strategic level, the insurgency continues to exploit global media to maximise the propaganda effect of IED strikes, simultaneously maintaining the support of those sympathetic to its cause, seeking to influence the views of populations in troop-contributing nations and, consequently, pressurising political decision-makers.

1.5.2 Strategic Impact. A particular aspect, at the strategic level, of IED use is its effect on the cohesion of an alliance and, importantly, the willingness of International Organisations (IO), Non-Governmental Organisations (NGO) and others supporting NATO's Comprehensive Approach (CA) to remain in theatre. It is likely that early withdrawal of such agencies would undermine the CA and necessitate the provision from other sources of the humanitarian and reconstruction support that they provide.

1.5.3 Conflict Scenarios. IEDs thus offer adversaries a lethally effective capability that is both inexpensive and, although tactical in its immediate effect, has the potential to have significant impact at the operational and strategic levels. While the current real-world focus is on IED use by adversaries supporting an insurgency, it should nevertheless be borne in mind that IED capability is also a potential factor within a wide range of crisis and conflict scenarios, including as a feature of hybrid warfare.[3]

1. Afghanistan Rights Monitor (ARM), quoted by the UN Office for the Coordination of Humanitarian Affairs, 23 Mar 10.
2. Defined by NATO as 'The set of political, economic, social, military, law enforcement, civil and psychological activities required to defeat insurgency and address core grievances.'
3. Though not currently formally defined, hybrid warfare in the context of this document is characterised by a combination of irregular activity and advanced capabilities, including in weapons and communications, that together offer predominantly non-state actors effects previously unavailable to them.

CHAPTER 11

IED Characteristics

2.1 IED Systems and Technologies

The design of IEDs is determined by a number of factors, including the availability of key components, the standards of training and experience of individuals producing IEDs, and the capabilities fielded by their intended targets. Given that practical constraints may deny an adversary complete freedom in the design and employment of IEDs, the most significant factor influencing these will be the intended effect. For example, the intention may be to cause maximum casualties and damage to infrastructure, or to target personnel and vehicles. The extent to which the intention is realised will depend on where IEDs are placed, their destructive capabilities and how they are delivered to the intended target. While patterns will inevitably emerge in any given theatre, a common feature of IEDs is the ingenuity often evident in their construction and emplacement. For example, multiple configurations and IED use in complex attacks are a feature of modern warfare, often combined with the tactical use of other weapon systems, including sniping. An important factor that limits the options of those using IEDs is their willingness to risk their own lives, with some individuals being prepared to undertake suicide attacks, and others wishing to escape harm or detection by remaining at distance from the intended target. These considerations allow an IED classification to be used, based on the method of initiation and deployment, as set out below.

2.1.1 Means of IED Initiation. From the perspective of A&S C-IED capability, the main IED initiation methods are as follows:

2.1.1.1 Timed IEDs, which offer an adversary a delay between emplacement and initiation ranging from seconds to months, as a result putting time and space between him and the detonation of the device;

2.1.1.2 Victim-Operated IEDs (VOIEDs), which are initiated by some action performed by the target, whether an individual or a vehicle; VOIEDs may incorporate a variety of firing switches and may be armed manually, with timers, or remotely;

2.1.1.3 Command-Initiated IEDs, which incorporate an element of separation between the main charge at the Contact Point (CP) and the firing point, allowing the operator to choose the optimum moment of initiation. Command-Initiated IEDs most commonly take the form of **Command Wire** IEDs (CWIED), where a firing current is sent along an electrical wire to the CP, and **Radio-Controlled** IEDs (RCIED), where a radio transmission is sent from the firing point to a receiver at the CP.

2.1.2 Methods of IED Deployment. The deployment of IEDs may be undertaken in a number of ways, for example:

2.1.2.1 Manually, where the device may be emplaced by hand or thrown into position in anticipation of a target. Such deployment is potentially capable of being detected using A&S assets. Alternatively, an IED may be delivered by an innocent or coerced party;

2.1.2.2 By Vehicle, whether ground-based vehicle-borne IEDs or via aircraft, including Unmanned Aerial Vehicles (UAV) and other small platforms;

2.1.2.3 Via Suicide Attack, allowing the operator to optimise the time and location to initiate an IED;

2.1.2.4 Through Projection, when IEDs are delivered to the intended target by direct or indirect fire (IDF) using rocket or mortar systems.

2.2 IED Tactics, Techniques and Procedures (TTP)

2.2.1 Resources. The TTPs employed by an adversary in his use of IEDs generally display a number of characteristics broadly conforming to the same principles of guerrilla warfare as, for example, the Mujahedeen fighters who inflicted significant losses on Soviet forces

in Afghanistan between 1979 and 1989. Speed, surprise, mobility and flexibility are integral factors in such campaigns, as are the favoured methods of ambush, sabotage and roadside IEDs, the latter often comprising HME main charges produced using commercially-available fertilizer. The use of military ordnance is also a common feature in the manufacture of IEDs, and locating, identifying and denying access to stockpiles of conventional ammunition should be a major consideration for friendly forces.

2.2.2 Electronic Countermeasures (ECM) Considerations. Methods of deployment and means of initiation tend to evolve over time, usually in response to advances in the means of detecting and defeating IEDs. For example, success in mitigating the threat posed by RCIEDs through the use of ECM may result in the adversary reverting to CWIEDs or victim initiation, or in seeking to defeat or circumvent ECM by identifying and avoiding the frequency range covered, or simply by out-powering fixed frequency ECM. Forces lacking an ECM capability altogether may find themselves increasingly targeted using RCIEDs, creating challenges for NATO and other alliances where ECM capability varies significantly between the forces deployed by different nations. Furthermore, increasingly sophisticated detection methods employed against IEDs may have the effect of encouraging an adversary to use IEDs that, although simple in their construction and means of initiation, are no less lethal. For example, VOIEDs can be produced from the most basic of locally available materials, potentially using few and/or very small metallic components.

2.2.3 Counter-C-IED. The evolving IED threat will therefore not necessarily involve increasing sophistication or destructive force, but could instead be apparent in simpler devices which are less reliant on external sources of components, potentially employed in larger numbers. An adversary's TTPs are also likely to change to reflect different approaches to COIN adopted by NATO forces in response to prevailing local circumstances. Where dismounted patrols are regarded as an appropriate means of pursuing campaign goals, use of VOIEDs may be more common, whereas in areas where patrols are routinely vehicle-mounted or conducted on Lines of Communication (LoC) used by convoys, the use of larger CWIEDs and RCIEDs is potentially more likely. Whatever the level of protection provided to NATO forces, the opponent can, if he wishes, ultimately overmatch that protection or circumvent it in other ways.

CHAPTER III

Countering the IED Threat

3.1 Principles

3.1.1 Joint Considerations. Countering the IED threat is fundamentally a Joint activity, with a range of capabilities contributing to the overall effort and intended effect. Within NATO, a wide range of nations, component commands, national and multinational agencies and other entities all exploit capabilities from across the different environmental domains and beyond (including from Joint organisations) and in various combinations. These may all be directed against specific aspects of an adversary's IED operations. Any attempt to consider A&S Power's role in C-IED operations in isolation of the contributions from elsewhere would, therefore, result in an incomplete picture. This is certainly the case in the Joint Intelligence area, where the ability to provide actionable intelligence is clearly understood; such intelligence results from transparent, coordinated Joint effort, enabled by swift, reliable feedback from multiple sources. It is therefore essential that in discussing A&S capabilities that contribute to the C-IED effort, these capabilities are always considered in the context of a Combined Joint operation.

3.1.2 C-IED and the Comprehensive Approach (CA). More broadly, the Combined Joint environment within which context C-IED effort takes place, itself sits within NATO's CA. The IED threat permeates all aspects of

Countering the IED threat is an inherently Joint activity.

the CA, affecting such civil actors as the Host Nation's civilian administration, IOs including the United Nations, NGOs and many others, and NATO's response must acknowledge this. To do otherwise would not only expose those working in these organisations to unnecessary risk but could potentially prompt their withdrawal, with the associated strategic implications. The creation of a secure environment and the provision of E&T are thus key considerations.

3.1.3 Countering the IED threat has been described as a perpetual game of cat and mouse, in which advances made in C-IED TTPs are swiftly countered by those using IEDs to pursue their aims and objectives. As already described, the evolving IED threat will not necessarily involve increasing sophistication or destructive power, but could instead be apparent in devices which are less reliant on external sources of components, and which are at the same time potentially both harder to detect and equally effective. An appropriate response to the IED threat, therefore, requires mental agility, experience, reliable intelligence on changes in enemy TTPs (which are updated regularly), and constant innovation. This sort of response is also supported by NATO's own approach, prescribing that three mutually-supporting strategies should be pursued concurrently. These strategies are:

- **Defeating the Device** once deployed and emplaced;
- **Defeating the System**, seeking to prevent the emplacement of IEDs by identifying and addressing an opponent's vulnerabilities at critical points in the IED system or network;
- **E&T.**

3.1.4 These strategies can be envisaged as being implemented through six 'Key Operational Activities' (KOA) that form the basis of a fully integrated and coherent approach to defeating the IED threat. As described in Chapter IV, A&S Power makes a full, often unique, contribution to this approach. These KOAs are:

3.1.4.1 Predicting IED-related activities, gathering and sharing all sources of intelligence as fully as possible, including developments in IED technology and adversaries' TTPs obtained from the maximum exploitation of IED incidents;

3.1.4.2 Preventing an adversary from conducting activities that result in the emplacement of IEDs, thus thwarting an attack: this is likely to require use of the full spectrum of Joint capabilities to defeat or disrupt the adversary while influencing local support, including through those capabilities delivering physical and psychological effects;

3.1.4.3 Detecting IED materiel and components, including stored HME and smuggled components, as well as emplaced devices themselves. This requires a combination of ISR capability, together with responsive processes and effective training, to ensure that potential IED activity detected is analysed and the results disseminated to all those who need to be aware of it, in order that appropriate action can be taken as swiftly as possible;

3.1.4.4 Neutralising emplaced IEDs and their initiation systems, using capabilities able to either destroy them, render them ineffective or to remove them altogether. This can be achieved by a variety of methods, including through the disruption of manual and RC detonation;

3.1.4.5 Mitigating the effects of IED detonation through: physical means, including enhanced protection for individuals and vehicles; responsive processes contributing to the fastest possible evaluation, exploitation and identification of lessons; Influence Activity (IA) that seeks to persuade, convince, deter, disrupt, compel or coerce target audiences into adopting a particular Course of Action (COA) or to assist, encourage and reassure those that are following a desired COA; and the reduction of potential target exposure through physical avoidance of emplaced IEDs;

3.1.4.6 Exploiting IED incidents by recording, analysing and acting on relevant information. In supporting the Lessons Learned/Lessons Identified process, this allows the development of effective C-IED TTPs.

3.1.5 Concurrency of KOAs. It is important to understand that the six KOAs can be applied both in the process of defeating individual IEDs and in attacking and defeating the networks that support their use. As described elsewhere, while C-IED efforts in a specific

case may be conducted with the primary aim of, say, identifying individuals emplacing IEDs (hence attacking the system or network), the same efforts may also serve to defeat the individual device in the act of being

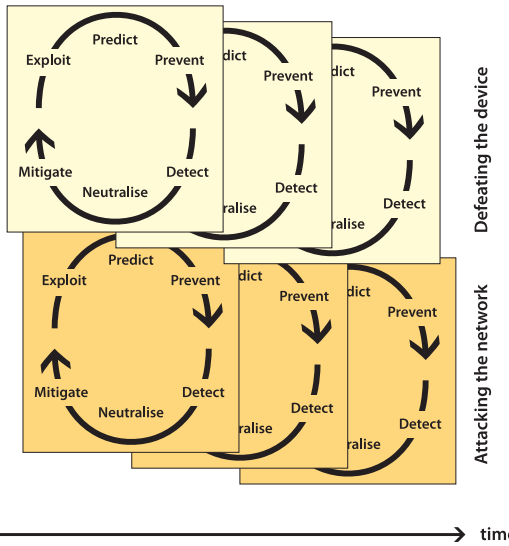


Figure 1 – Concurrency of C-IED KOAs.

emplaced. Therefore, C-IED can be imagined as concurrent activity to pursue both these strategies (counter-device and counter network), with each set of specific activities interrelating, to differing degrees, with the other. This is set out schematically at Figure 1.

3.1.6 Interrelationships between KOAs. In addition to the interrelationship between counter-device and counter-network efforts, within each discrete C-IED operation of either kind, the degree of success achieved

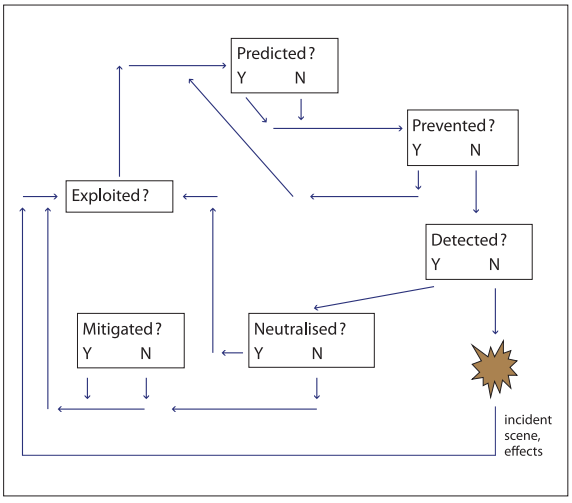


Figure 2 – KOA Interrelationships.

by each of the KOAs will determine what subsequent action is required. For example, if an operation has successfully *prevented* the emplacement of one or more IEDs, the need in that particular instance to seek to *detect* IEDs will have been removed. However, only partial success in *preventing* the emplacement of IEDs will require that efforts are made to *detect* emplaced IEDs. The level of success in *detection* will, subsequently, determine the extent of the requirement to *neutralise* or *mitigate* emplaced devices. A generic flow diagram illustrating this point is at Figure 2.

3.2 Countering the IED Threat in Practice

3.2.1 Wider Context. As already discussed, C-IED operations are inherently Joint in nature; this is also borne out in practice. In order to understand the practical contribution to the Joint C-IED effort made by A&S Power, we need firstly to consider the wider context within which C-IED is itself conducted. In particular, and accepting that the use of IEDs can be a feature of the full spectrum of conflict activity, contemporary operations demand that NATO focuses on IED use as an aspect of asymmetric, insurgent-led conflicts. In such a conflict, the relationship between C-IED and COIN is worth closer consideration.

3.2.2 C-IED as a Facet of COIN. The use of IEDs, and the consequent need for C-IED capability, represents one element of a COIN campaign. There is, however, a danger that the tactical, operational and strategic impact of IED use will result in an emphasis being placed on C-IED operations at the expense of wider COIN goals. When the potential impact of IED use is already becoming apparent in an emphasis on C-IED operations, the perception can readily arise that COIN and C-IED operations always share common aims and objectives. This may be the case where, for example, efforts made to interdict trans-frontier land LoCs in order to disrupt the inbound and outbound movement of illicit cargoes of value to an insurgency, also prevent key IED components from reaching their intended destination. Activities such as these therefore serve both the broader interests of a COIN campaign as well as the specific needs of C-IED operations.

Furthermore, given that insurgents' networks fulfil a variety of purposes other than facilitating the manufacture, storage, transportation, and employment of IEDs, the philosophical distinction afforded specifically to IED networks can, on the ground, appear artificial, where such distinctions are less clear-cut. In reality, a veritable spider's web – or perhaps collection of spider's webs – of networks exist, mutually supportive in whole or in part. These networks can include those associated with ethnic rivalries, tribalism, filial loyalties and criminal groupings, any of which may support the production and use of IEDs. Commanders must understand the relationships between IED networks and other networks, the potential implications of C-IED operations directed against them, and the kinds of circumstances where C-IED operations and COIN operations serve different purposes, if the pursuit of one is not to be at the expense of success in the other.

The effectiveness of Shows of Force and Shows of Presence in C-IED operations depends on an understanding of target audiences' perceptions.

3.2.3 C-IED and A&S Power. As we have seen, it is important to understand the distinction between the aims and objectives of C-IED operations and the requirements of a broader COIN campaign; while the two may often be mutually supportive, this is not necessarily always the case. This distinction is also apparent in the relationship that exists between NATO's potential A&S contribution to Joint C-IED operations and to wider campaign goals. For example, while the A&S contribution to C-IED can be viewed as a combination of the platforms, sensors, systems, processes and procedures that together offer C-IED capabilities – and could therefore be labelled as 'A&S C-IED capability', in reality these represent part of a much broader suite of capabilities in all environments, including land, maritime, Special Operations Forces (SOF) and so on, that all contribute to, but are not devoted exclusively to, the C-IED effort. The challenge is therefore to view the A&S contribution to C-IED effort as one element of its role in the broader COIN campaign. This is important because decisions on apportionment made by air commanders need to be on the basis of both the intended impact on the broader COIN campaign and, at the same time, mindful of the potential effect on C-IED operations – and

vice versa. In concentrating on one at the expense of the other, commanders must consider the potential adverse impact on COIN and C-IED efforts respectively. For example, Alliance Air Power used in support of targeted IA, such as Shows of Presence (SoP) and Shows of Force (SoF), may be intended primarily to deter IED emplacers. However, depending on how they are viewed by target audiences, of which there may be several for each such individual activity, they may in fact cause sufficient nuisance or fear to undermine civilian support for an alliance. In the worst case, the net effect may be to encourage local populations to align themselves with the adversary, including in supporting his IED campaign, at the expense of relationships between local populations and alliance forces. A specific issue here is how Measures of Effectiveness (MoE) are developed that provide some objective evidential data on how actions intended to have a particular effect on a target audience are actually perceived by that (or other) audiences.

3.2.4 Mutually Supportive A&S Activities. Having noted the challenges of identifying the unintended second-order effects of A&S operations aimed at achieving specific C-IED and COIN effects, it must be remembered that there are other areas where A&S efforts simultaneously serve both COIN and C-IED aims. These may include efforts to train local forces in C-IED TTPs, addressing at the same time the needs of the short (and perhaps longer-term) C-IED fight, and the strategic aims of the COIN campaign, such as setting the conditions for a theatre exit strategy. It is also worth bearing in mind that C-IED operations represent, both in principle and in reality, one element in a wider COIN campaign, and while the strategic and operational focus of A&S capabilities should remain on delivering the full range of effects in support of COIN goals, where the use of IEDs risks undermining the overall success of the COIN campaign, commanders may, nevertheless, be obliged to afford C-IED their highest priority.

3.2.5 A&S Power and C-IED – Supporting Processes. The fullest exploitation of NATO A&S Power capability in C-IED operations is reliant on those processes, organisational structures and networks that are in place to plan, coordinate and execute C-IED operations, and to analyse, assess and disseminate the effects achieved. These processes and their supporting structures are frequently complex, reflecting the need to engage and cooperate with a large number of agencies and actors. Operationally, a close working relationship is essential between: the Subject Matter Experts (SME) within the main C-IED coordinating organisation (often a C-IED Branch or Cell); those responsible for overall coordination of A&S capabilities; and, within the A&S tasking and coordination organisations themselves, between those SMEs with responsibility for specific aspects of support to C-IED, including Electronic Warfare (EW) and ISR. Once established, and subsequently maintained and supported by properly configured staff structures, these relationships will permit the best possible prioritisation and allocation of assets to the C-IED effort. Process-related factors include:

3.2.5.1 Mission Planning. For prioritisation and allocation of assets to succeed, it is essential that those with responsibility for allocation of particular assets, for example ISR platforms, are included as early as possible in the process of planning a Joint mission. This will allow relevant ISR assets to be better integrated into the overall plan and will provide sufficient time, prior to execution, for liaison between the agencies involved, both in the air and on the ground. This will apply to most types of operation and is not dependent on its nature or scale;

3.2.5.2 Air Tasking Order (ATO) Constraints. In reality, the requirements of a standard ATO cycle may not always allow sufficient time for maximum coordination and, therefore, optimal mission planning, between air and ground assets. Depending on the type of mission, the overall operational design and the desired effect, it may be appropriate to allocate A&S capabilities to the lowest level of command for a finite period, giving the commander at that level the greatest degree of control over those capabilities. This will permit him to plan detailed operations with the confidence that the A&S capabilities, or more precisely the effects, requested will be available, maximising their utility in the C-IED effort;

3.2.5.3 Feedback Loops. The importance of feedback, whether in the form of a land formation acknowledging the receipt of A&S-provided C-IED intelligence products, or aircrew and analysts having potential IED finds confirmed, underlines the challenge of establishing swift, reliable, means of providing that feedback. For example, while the ability of aircrew and analysts to successfully identify emplaced IEDs would be improved by the confirmation fed back to them that a potential find was in fact an IED, those on the ground are more likely simply to avoid a potential IED than to investigate it. Consequently, the potential find is not confirmed and the knowledge and experience – and morale – of aircrew and analysts are adversely affected;

3.2.5.4 ISR Support Structures. Tasks such as detection, discrimination and tracking from the air are onerous, particularly in remote or urban areas. They place considerable demands on ISR support, data exploitation and intelligence dissemination networks. Meanwhile, the emphasis in C-IED operations on reconnaissance and surveillance assets has been described as 'overwhelming ISR', in contrast to the more traditional 'overwhelming force.'[1] Furthermore, the crucial importance to C-IED of ISR operations itself underlines the need for all-source, inter-agency intelligence, processing and dissemination infrastructure capable of exploiting ISR products. In C-IED network terms, this can be summarised as *'making a network to break a network'*. In other words, regardless of the number of platforms, sensors, overhead passes and innovative technologies employed in C-IED operations, there is a fundamental need for agile, responsive processes, universally understood and consistently applied. Processes must be capable of acquiring IEDs or IED-related targets, allowing informed decisions to be made at the right – not necessarily the lowest – level on the actions necessary, including marking, engaging, detaining or exploiting the acquired target. To achieve this, processes must be designed to be inherently swift, flexible and able to respond rapidly to changing circumstances or opportunities. Furthermore, they must be fully understood and must be as free as possible from organisational, structural and security-driven constraints. Most importantly, they must actually be used; only through their application will they evolve to reflect the dynamic demands of C-IED operations.

There is a need for agile, responsive C-IED processes, universally understood and consistently applied.

3.3 Strategic Considerations

3.3.1 Strategic-Level Processes and Structures. The emergence and proliferation of IEDs in recent operations has resulted in a wide range of national, multinational and coalition activities intended to find ways of addressing the threat. While often effective in developing approaches to deal with the IED threat in its current form, these activities risk duplication of effort and limited visibility between different programmes and projects. Consequently, the need to establish shared awareness of C-IED efforts through better coordination – though ideally avoiding the creation of more network nodes – has been recognised at National and NATO levels.

3.3.2 Strategic Communications (STRATCOM). In 2009, NATO introduced a new STRATCOM policy, designed to coordinate a number of functions at the strategic level and, in so doing, providing support to the CA. As we have seen, the use of IEDs can present a significant threat to alliance cohesion, and robust STRATCOM, delivering a consistent message at the highest level can serve to counter this effect. Target audiences for a coherent STRATCOM approach include domestic populations and politicians, IOs and NGOs, the Host Nation population and, potentially, adversaries.

3.3.3 Joint IED Defeat Organization. The US Joint IED Defeat Organization (JIEDDO) has been in existence since 2006, charged with overseeing US efforts to counter the threat of IEDs, and now represents a cornerstone of US C-IED capability. Its activities currently include: exploring technologies with potential C-IED utility; controlling procurement of C-IED equipment of all kinds; and delivering Joint Centre of Excellence training. Notwithstanding the achievements of the JIEDDO to date, the range and complexity of C-IED activities conducted nationally resulted in the creation of a Department of Defense C-IED Task Force in 2010.

3.3.4 NATO C-IED TF. At the Alliance level, the need for cohesive and coordinated effort throughout NATO organisations, structures, components, and nations has been recognised by the establishment of a NATO C-IED TF. In implementing an agreed C-IED Action Plan, the TF coordinates efforts to validate strategic, operational and tactical requirements and works towards ensuring that the management of technological developments and industrial solutions is conducted through appropriate NATO bodies. It also addresses coherent, mutually reinforcing capability requirements with the European Union (EU).

3.3.5 C-IED Centre of Excellence (CoE). A further focusing of C-IED effort across the Alliance will be provided by the NATO-accredited C-IED CoE, expected to achieve full operational capability in 2011. One of a number of independent, NATO-accredited CoEs (including the JAPCC) whose activities are coordinated by the Transformational Network Branch of Allied Command Transformation, the C-IED CoE will offer independent expertise and capacity, complementing and supporting the NATO C-IED TF, potentially exploiting the utility of an electronic C-IED 'portal'.

1. Kemsley, H: 'Combat Air Power in Irregular Warfare: Operational Utility, the Lack of Narrative and the Risk of Strategic Failure'.

NATO A&S Power can make a decisive contribution to C-IED operations, both in defeating the device and the systems on which it depends.

CHAPTER IV

The NATO Air and Space (A&S) Power Contribution to C-IED

4.1 General

NATO A&S Power offers a broad variety of capabilities that, individually and together with other assets, can make a decisive contribution to C-IED operations, whether in defeating the device once assembled and emplaced, or in attacking the system or network that supports IED production and use. This contribution includes ISR assets tasked independently or cued by other ISR capabilities, the employment of airborne or Space-based Coherent Change Detection (CCD) technologies, the application of precision attack, and the inherent ability of airborne assets to mitigate the effects of IEDs by using their own environment to circumvent the threat and, importantly, the rapid movement of specialist personnel and exploitable materiel. This Chapter will consider the ways and the extent to which each of these stands to contribute to Joint C-IED effort in contemporary operations, both in defeating the device and attacking the IED network.

4.2 A&S Power – Defeating the Device

4.2.1 In simple terms, A&S Power is capable of defeating emplaced IEDs by detecting devices and by neutralising and mitigating their effects, as follows:

- **Detecting** devices using dedicated airborne and Space-based ISR and airborne Non-Traditional ISR (NTISR),[1] exploiting existing capabilities and capitalising on technological enhancements, including those offered by CCD technology;

- **Neutralising** devices and **Mitigating** their effects through:

- Airborne EW capabilities, including Electronic Attack (EA), by employing ECM to disrupt or detonate RCIEDs;
- The initiation or disruption of IEDs using kinetic targeting via airborne (or potentially Space) platform-based weapon systems, including by direct fire;
- The physical avoidance of emplaced IEDs using Air Mobility, utilising Fixed-Wing (FW) and Rotary-Wing (RW) intra-theatre airlift, including the use of Air Despatch[2] capabilities.

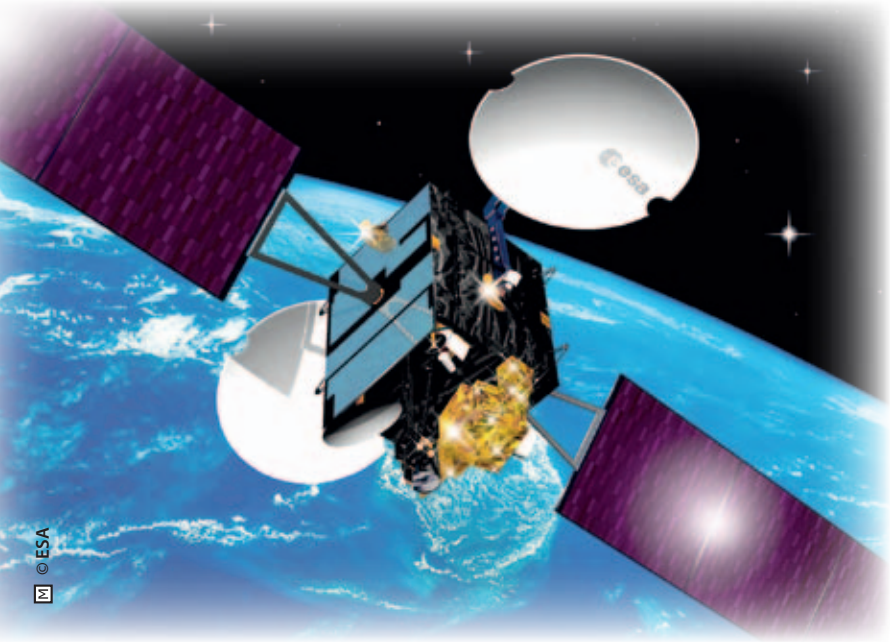
4.2.2 Detection of IEDs. In practice, the use of A&S Power to defeat the device is predominantly focused on the detection of emplaced IEDs, achieved through the use of ISR capabilities, either individually or in combination ('layered'), both persistent and non-persistent. Employing scarce and expensive A&S assets in this way can appear disproportionately resource-intensive, an impression frequently reinforced by the challenge of producing significant, rapid and measurable results within the dynamic tempo that characterises the contemporary operational environment. Without readily-available MoE, there is a danger of C-IED capability – potentially useful in a variety of applications requiring the flexibility, speed and responsiveness that it offers – being used instead primarily in pre-planned, as opposed to reactive, operations. It may even be diverted to non-C-IED tasks which are less critical to overall success, but where MoE result in tangible results being more likely to be apparent. Commanders must, therefore, plan carefully their employment of A&S C-IED capability, the intended effects, and possible MoE. NATO A&S Power is capable of detecting IEDs in a number of ways, as set out below.

4.2.3 Airborne ISR. The ability of A&S assets to detect emplaced IEDs consistently and reliably has in recent years benefitted from significant technological development. Among many enhancements, infrared (IR) and electronic imaging represent important steps forward, and other Multi-Sensor ISR (MSI) configurations are capable of bringing together multiple systems, providing the kind of persistent, layered ISR capability that is the key to successful airborne ISR-delivered C-IED. Ongoing research in airborne ISR detection technologies includes systems able to sense electromagnetic emissions, those with improved IR capability, new Synthetic Aperture Radars (SAR) and such capabilities as ground-penetrating radars, potentially mounted on small UAVs as well as on manned platforms. Nevertheless, achieving substantive, repeatable results remains a challenge, and there is likely to be pressure on ISR assets for other tasks. Furthermore, the optimisation of airborne ISR remains reliant on both the provision of appropriate E&T to the audiences identified in Chapter V, and on processes able to exploit the data collected, and described in Chapter VI. Lastly, device detection is requiring sensors to become more and more specialised and highly sensitive. The number of sensors needed to detect all of the various types of IEDs is expanding and is expected to continue to do so. As such, it is important to seek a 'plug and play' capability so that multiple types of sensors can be utilised and exchanged on a single airborne platform. A UAV, which minimises risk to human life, may be preferable because it can provide long endurance and is difficult to detect in the air. Plug and play capability also minimises the use of ramp space and the number of personnel required to operate a completely separate platform. When nations are seeking to procure a new sensor for C-IED (or other) missions, it is, therefore, desirable that the sensor is capable of operating on UAV types already used by that nation. Likewise, if a nation is procuring a new UAV, the platform should be able to operate multiple sensor types, themselves capable of being exchanged depending on the mission.

4.2.4 Space-Based ISR. There is a widespread view that the simpler the IED, the less useful is Space-based ISR in detecting it. While this may be the case, for example, in respect of small VOIEDs constructed from basic materials, larger or more complex devices are susceptible to detection using existing CCD technologies. In fact, one of the most significant factors limiting the use of Space-based ISR in defeating emplaced IEDs lies in the finite number of satellite passes available in any given period. Apart from its own ISR contribution, the utility of Space capability in the counter-device role may instead fundamentally lie in providing,

or at least facilitating, the more rapid passage of warnings from Space-based, airborne or ground-based ISR capabilities to personnel in the vicinity of a threat – including potential emplaced IEDs, as well as to other agencies. In short, while Space-based ISR capability needs to be deployed in a way that capitalises on its strengths, including in CCD, this should not detract from its key role in enabling rapid and reliable communications. As with airborne ISR, relevant E&T and robust, agile, well-understood processes are needed if the maximum C-IED benefit is to be gained from this and other Space-based capabilities.

4.2.5 NTISR. The difficulty in justifying the use of A&S capability in C-IED operations, particularly where MoE are elusive and when there are multiple demands on inevitably finite resources, is exemplified by the use of fast jet hours to overfly LoCs and other key terrain, expending NTISR effort with apparently limited results. If success is defined in terms of the number of emplaced IEDs positively identified, this view has some justification. However, if success is instead gauged on the basis of, for example, the deterrent effect on emplacers,[3] or on their having to resort to hasty emplacement of IEDs that in turn increases the likelihood of their detection and identification – including by NTISR assets, such monitoring of LoCs may appear more productive. This again underlines the importance of MoE. Notwithstanding desirable second-order effects such as these, the ability of NTISR capability to detect emplaced IEDs is itself improving, with sensitive Electro-Optical (EO) sensors, together with digital imagery and real-time data links, improving the evaluation of the resulting Imagery Intelligence (IMINT), and with better IR fidelity being capable of detecting recent digging for extended periods of time. However, unless cued with other ISR or EW assets the likelihood of detecting IEDs using NTISR capability remains comparatively limited. That said, assuming that the primary purpose of fast jet sorties is not adversely affected, and given the availability of the necessary sensors and data links, a C-IED contribution can result using flying hours that otherwise would have been expended in less productive activities, such as maintaining an orbit in anticipation of tasking.



Space-based systems make a unique contribution to the C-IED fight, both in detection and in enabling rapid, reliable and robust communications.

4.2.6 Three Key Considerations. The importance of airborne and Space-based ISR in the detection of emplaced devices is clearly apparent, as is the need for readily-applied MoE in better understanding the totality of its overall contribution. However, three further factors influence the success of A&S capability in device detection, and should be kept in mind when considering its operational employment. These are: *Timeliness*; *Persistence*; and *Training*.

4.2.6.1 Timeliness. The limitations on A&S capability in its ability to successfully detect emplaced IEDs are partly a consequence of the time elapsing between a potential IED being detected and appropriate action being taken to follow it up, whether to neutralise or mitigate the threat, or to exploit the find. The possibility exists that there will be sufficient time for the emplacer to remove and relocate the device detected, effectively eradicating all potential advantages – both practically

and in terms of E&T benefit – of its original detection. The processes through which airborne or Space-based ISR detects a potential IED, and through which that find is investigated, therefore need to be as swift as possible, with those personnel required to use these processes having a clear understanding of their contribution to overall success.

4.2.6.2 Persistence. The ability of ISR capability to detect the emplaced device (as well as the various 'nodes' within an IED network) is usually improved when persistent ISR can be brought to bear. By employing persistent ISR, cleared areas, LoCs and so on can be held over time, allowing ground units to pass over them without the risk of that area having been 're-seeded' with IEDs. This can serve the interests of convoy moves as well as dismounted patrols and other activities aimed at engagement with local communities and, although the tactical-level 'ownership' of key assets – including small UAVs – may appear to serve the interests of persistence, the fullest exploitation of persistence may in fact be more reliant on better integration and ISR data-sharing than on who owns the platform.

4.2.6.3 Training. The role of A&S capability to detect and defeat IEDs highlights the importance of relevant E&T, itself one of the three concurrent C-IED strategies identified in NATO doctrine. The fullest exploitation of ISR assets to detect emplaced IEDs requires that all those with a stake in the process, whether planners, attack aircraft aircrew, imagery analysts, information managers, communications specialists or others, are given the E&T relevant to their specific role and the contribution that it makes to the overall effort. Given the inherently Joint nature of C-IED operations, E&T also needs to impart an understanding of the contribution made by the other components to the overall success of the NTISR provided. This is discussed further in Chapter V.

4.2.7 Neutralising and Mitigating the Effects of IEDs. As well as the use of ISR to detect emplaced devices, A&S Power offers a number of other capabilities that can be employed in a C-IED role, specifically to neutralise and mitigate their effects, whether or not

The success of EW capabilities in C-IED requires regular, relevant E&T.

detected using A&S assets. These are considered in the following paragraphs. One of these capabilities – Air Mobility – can also be used to exploit IEDs once detected and neutralised.

4.2.7.1 EW. With the ability of ECM to mitigate and neutralise the effects of IEDs being largely provided via land-based systems, the main focus for A&S Power is in the area of EW. Airborne EW has the potential to affect both IEDs and the communications on which those seeking to employ them rely, consequently disrupting their ability to execute attacks at a time and place of their choosing. Within EW, Electronic Attack (EA) also represents an important aspect of overall capability. In addition to an alliance's ability to deploy and maintain the technology necessary

to prosecute electronic counter-device operations, the success of EW is reliant on a number of factors, foremost amongst which is E&T. For example, specialist EW Officers (EWO) require regular refresher training if their knowledge is to remain current in an area where even short absences from a theatre of operations can result in their relying on earlier, often out-dated, knowledge and experience. The same is true of Forward Air Controllers (FAC) and Joint Terminal Attack Controllers (JTAC), whose skills require them to maintain EA skills in addition to those required to deliver kinetic effects onto a target, and of commanders, whose individual and collective E&T needs to equip them to 'ask the right question' when seeking airborne C-IED EW support for particular operations.

4.2.7.2 Kinetic Effects. The use of kinetic effects to support C-IED efforts offers the prospect of defeating the emplaced device by initiating an IED's main charge, or disrupting the ability of an adversary to detonate it himself, using A&S capabilities, including by direct fire. This effect could be delivered using weapon systems as diverse as fast-jet mounted conventional munitions and specialist small arms deployed on RW platforms. Research undertaken in late 2009[4] considered a number of 'effectors' currently capable of delivering an effect on emplaced IEDs once detected and, in addition to the use of conventional ammunition, raised the possibility that fluorescent dye marking of IEDs, airborne heat sources and high-pressure water guns may have near-term contributions to make in the kinetic targeting of IEDs from the air. The potential of Directed Energy Weapons (DEW) has also been considered, with land-based lasers being tested successfully against a variety of IED types and the possibility of their being mounted on airborne platforms also in prospect.[5]

4.2.7.3 Air Mobility. Air Mobility has a unique role to play in circumventing and, therefore, avoiding altogether the physical threat posed by IEDs. By making maximum use of intra-theatre airlift, the requirement to move personnel, equipment and stores by road is reduced, and NATO forces are able to make full use of a capability that is unlikely to be available to an adversary. Using RW and FW capability, an alliance can thus, on the face of it, effectively neutralise the IED threat and, where surface movement is necessary, Air Mobility assets can serve to re-establish, via Overwatch and downlinks, a degree of the Situational Awareness (SA) lost when personnel are required to operate from within heavily armoured protected mobility and protected patrol vehicles.

4.2.7.4 Air Mobility can also provide the rapid movement of C-IED specialist teams and exploitable IED materiel. Serving both counter-device and counter network purposes, this is considered in more detail at Paragraph 4.3.8. In seeking to make the most of what is in effect an asymmetric advantage, capabilities such as Air Despatch can also be considered, with recent developments in GPS-guided Air Despatch complementing

unguided drops and allowing the delivery of stores, including food, water, ammunition and construction materials, into small forward operating bases and patrol bases. Current capability within NATO also includes tilt-rotor Air Mobility, and this offers the potential of significant benefit in its ability to avoid the IED threat while combining many of the practical advantages of intra-theatre RW and FW capabilities. However, the clear benefits of maximum recourse to Air Mobility must be set against a number of potential disadvantages which, though to an extent scenario-specific, should nevertheless be considered. These are as follows:

- In a COIN scenario, the use of Air Mobility may further reduce the ability of alliance forces to engage with and reassure the local population, and in this respect may to an extent be self-defeating;
- Greater reliance on RW and FW assets for intra-theatre movement may result in an adversary evolving his TTPs, targeting Helicopter Landing Sites (HLS) and Tactical Landing Zones (TLZ) with IEDs, as well as with other weapon systems including small arms, rocket propelled grenades and IDF;
- Intra-theatre Air Mobility assets are usually limited in number and subject to multiple, sometimes conflicting, tasking;
- Practical constraints on the use of Air Mobility may include a limited number of suitable aircraft, limitations on ramp space, specialist training requirements (for example to conduct Air Despatch), and the need to regularly re-role aircraft.

4.2.8 Defeating the Device – A&S Capabilities and KOAs. In summarising the role of NATO A&S Power in defeating emplaced IEDs, the six KOAs described in Chapter III offer a useful framework within which to highlight the predominant counter-device contribution made by each of the broad capability areas referred to in this Primer. There will inevitably be exceptions where, for example, RW platforms employed in an NTISR role undertake the 'predict' KOA. Equally, the capability types

Air Mobility can re-establish a degree of Situational Awareness when the IED threat necessitates that personnel operate from armoured vehicles.

A&S Capabilities	Key Operational Activities (KOA)					
	Predict	Prevent	Detect	Neutralise	Mitigate	Exploit
Fixed-Wing (FW)		■	■	■	■	
Rotary-Wing (RW)		■			■	■
Air Mobility		■			■	■
Space-based ISR	■	■	■			
Airborne ISR	■	■	■			
Non-kinetic effects/ Influence Activity (IA)	■	■		■		■
Electronic Warfare (EW)		■	■	■	■	
Kinetic effects		■		■	■	
UAV	■	■	■			

Figure 3 – Defeating the Device – A&S Capabilities and KOAs.

used are both more generic and more sharply defined than in reality. Nevertheless, the schematic at Figure 3 provides a snapshot of the relationships between KOAs and A&S capabilities, with shaded areas indicating utility against individual KOAs.

When operationally appropriate, the use of Air Mobility allows an IED threat to be circumvented.

4.3 A&S Power to Defeat the System

4.3.1 It is sometimes suggested that NATO's A&S capability is, in C-IED terms, predominantly configured to detect and, to a lesser extent, neutralise and mitigate the threat posed by emplaced IEDs. As a consequence of this view, its ability to contribute to the second of NATO's approaches to the challenge – attacking the IED system or network, may be seen as comparatively limited. Experience of recent operations indicates that that this is not in reality the case, and suggests that this view arises, at least in part, from the challenge posed in differentiating in practical terms between action that is specifically intended to defeat the device, and that which is primarily designed to defeat the system; thus action aimed at defeating the device may lead to success against the IED system as a whole, for example through the forensic exploitation of recovered IED materiel. Similarly, the use of A&S capability to target activities associated with the emplacement of IEDs may serve to contribute to both attacking the system and to defeating the individual device itself. Once again, however, A&S capability should not be regarded in isolation. While it can provide the sensor capability for a Joint C-IED package intended to attack the network, when employed on its own it lacks the ability to, for example, detain a suspect, and thus does not necessarily possess the ability to conduct the full range of counter-network roles.

4.3.2 Networks. Before reviewing the particular contribution made by A&S capability to defeating the IED network, it is worth reiterating one further factor that also serves to complicate the issue; not only is it potentially difficult to distinguish, other than in terms of intended effect, between counter-

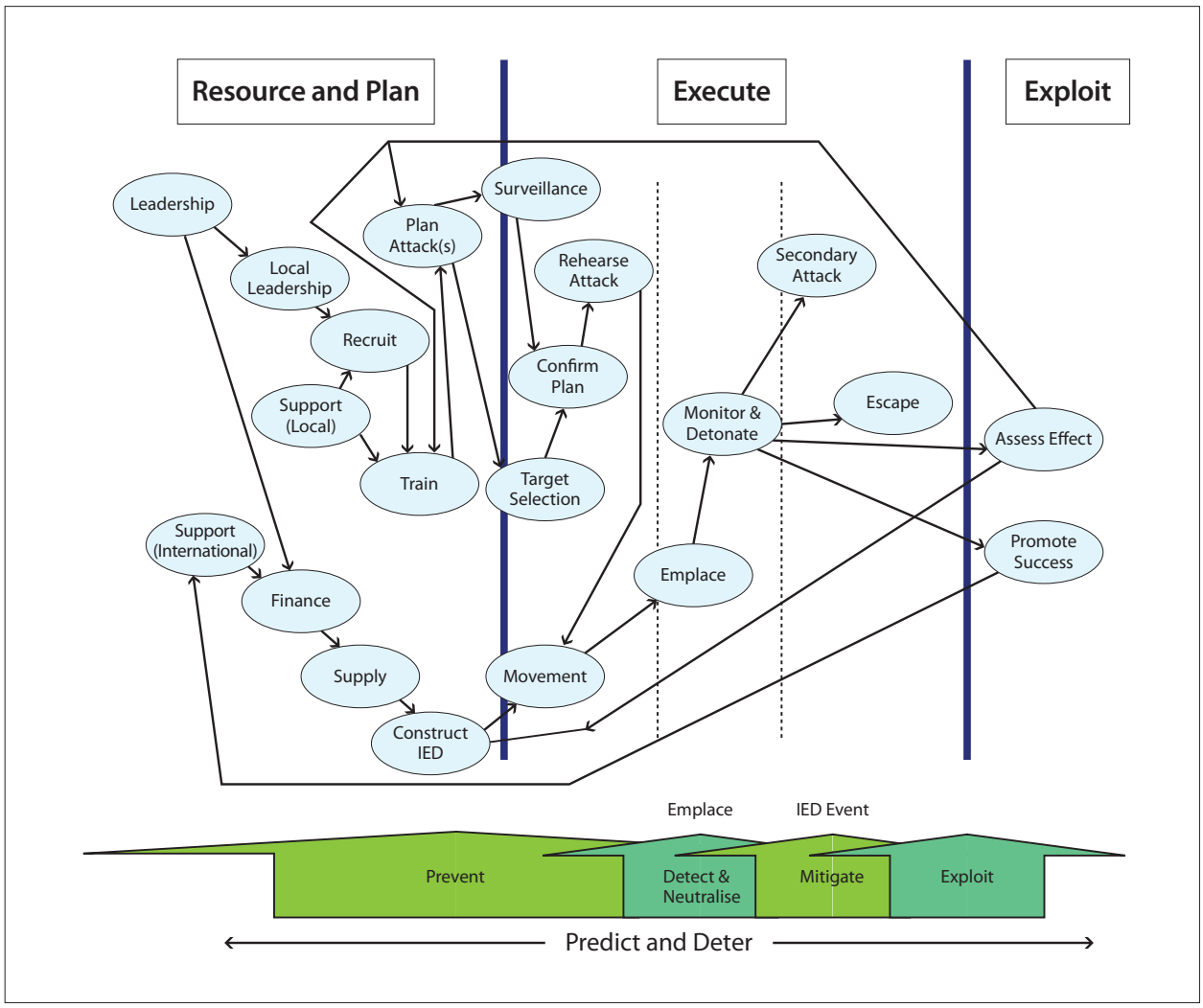


Figure 4 – Generic IED Network.

network and counter-IED activities, the distinction between IED networks and other networks used by insurgents is, as we have already seen, also itself often little more than notional. Nevertheless, a number of agencies have produced schematics seeking to visualise the key features of IED networks. In essence, these comprise their constituent element or 'nodes', both physical (for example the facilities used to construct IEDs) and conceptual (including the ability to train and to plan attacks), and three recurring phases: resource and plan; execute; and exploit. For any single IED attack, these phases will occur in sequence, but in the course of ongoing IED use are likely to take place simultaneously. A generic IED network schematic, derived from work undertaken in the UK and the US, is at Figure 4.

4.3.3 Accepting that IED networks are less clearly defined on the ground than they are conceptually, the key to attacking them involves identifying and addressing an opponent's vulnerabilities at critical points in the network in order to prevent the emplacement of IEDs in the first place. NATO A&S Power can bring to bear a range of capabilities that contribute to the achievement of this aim, specifically:

- The full use of airborne and Space-based ISR capabilities;

- The ability of airborne and Space-based assets to detect and collect actionable intelligence over a longer timeframe than is available from other sources, including through the use of Space platforms to provide long-term perspectives on strategic issues;
- The ability, including through EW, SoP and SoF, to disrupt and deter IED activity, and through IA to seek to gain local support for alliance actions;
- The use of Air Mobility to support counter-network activities.

4.3.4 The employment of each of these capabilities is considered in a counter-network role in greater detail in the following paragraphs.

4.3.5 Defeating the IED System – ISR. The unique ability of airborne ISR and NTISR platforms and sensors to support counter-network operations, when compared with non-airborne or Space-based sensing capabilities, comes primarily from their agility, speed, reach and persistence. In deploying the full range of sensors as collectors, all types of intelligence, including Signals Intelligence (SIGINT) and IMINT, can be brought to bear against the IED network. Although the utility of airborne NTISR in this role is usually more limited than that of specialist ISR capabilities, with training and experience the detection of changes on the ground, for example in the position and size of temporary structures, the extent of vegetation and the movement of vehicles, can be reliably identified and interpreted. Similarly, Space-based capability has the potential to identify and monitor patterns of life, identifying changes over time and making possible the targeting of individual nodes within the IED network; nodes may include individuals, production, storage, and staging and transportation facilities. As with airborne ISR, Space-based sensing capabilities can identify network nodes through a variety of indications, including changes in the routines of individuals or groups, the arrival, expansion or removal of man-made features including settlements and encampments, and changes in apparently natural features, such as vegetation or watercourses. However, without sufficient well-trained analysis capability or useful MoE, there is a danger of the data collected not being fully utilised. The use of Space-derived intelligence against IED networks is further complicated by the fact that high demand, low density capabilities, such as those provided by Space assets, need even more reliable MoE to ensure that the effort expended in C-IED network missions is justified by the results. It should be remembered though that tasking Space-based platforms and sensors for a particular mission does not necessarily mean that they cannot undertake other missions and tasks concurrently. Furthermore, the full use of Space-derived products is constrained by procedural factors; considerable effort and ingenuity may be needed by those with access to Space capabilities to provide access to others without breaching releasability protocols. E&T has a part to play here as well, both in ensuring that those requesting Space products are assisted with asking the 'right' question, and more generally to make sure that commanders at all levels are as well informed as possible about how Space-based ISR can support C-IED network operations.

4.3.6 Use of ISR to Defeat the System – Key Factors. The key factors influencing the success of airborne and Space-based ISR capabilities in attacking and defeating the IED system or network are:

- The maximum integration with other ISR and EW assets, including those on the ground, providing layered, cross-cued effects;
- Mission planning that reflects the fullest utilisation of key A&S Power attributes, particularly that of persistence, when compared with ground-based ISR collection, and which is purposeful and intentional;
- The ability, with the necessary planning and coordination, for Space-based assets to conduct concurrent missions, with the data collected being analysed by different means and for different purposes;
- Relevant E&T;
- Collection capability matched by the ability to swiftly and accurately analyse, and subsequently deliver, actionable intelligence.

4.3.7 EW Capability to Defeat the System. As with the use of EW in a counter-device role, the provision of relevant, focused E&T is an essential prerequisite

for its successful employment in attacking and defeating the IED network. This is particularly true for EWOs, whose skills and knowledge require regular updating if they are to exploit successfully the available capabilities, and of commanders, who need to be aware of the EW capabilities available to them. Used in conjunction with other capabilities and coordinated within a comprehensive Information Operations (Info Ops) plan, airborne EW capability can make a significant contribution to the disruption of IED networks, and can do so in ways that are less apparent to an adversary than a more overt approach – and thus have considerable benefit in gaining actionable intelligence. Given that such capabilities are likely to be limited in scale and number, and that there will be conflicting demands on available resources, it is particularly important that airborne EW does not duplicate other, similar, capabilities and, in particular, that that EW effort is brought to bear in supporting other forces – usually on the ground – that lack their own organic EW capability.

A key Air Mobility contribution to counter-network operations is the rapid exploitation of IED incidents.

4.3.8 Counter-Network Air Mobility. The role played by Air Mobility in mitigating the need for surface transit, and the corresponding reduction in exposure to emplaced IEDs, is complemented by its ability – again exploiting Air Power's inherent agility, speed and reach – to provide the rapid movement by air of those capabilities and personnel engaged in counter-network operations. These may, for example, include SOF, Human Intelligence (HUMINT) and Civil-Military Cooperation (CIMIC) teams, though here again, the actions that are ostensibly aimed at countering the IED network may look remarkably similar to those undertaken with broader COIN aims in mind. This is the case too when Air Mobility is used to support, for example, Key Leader Engagement (KLE), which in serving the wider campaign interests also contributes to C-IED network efforts. One area where Air Mobility can be used in a specifically counter-network role, however, is in the transportation of IED exploitation teams, who need to be able to move rapidly to IED incident sites and other locations in order to produce comprehensive, evidence-based actionable intelligence. Such intelligence is by its very nature often time-critical, and may allow action to be taken against individual or collective nodes that may themselves appear physically remote from the emplaced IED, but which contribute to the overall IED campaign.

4.3.9 Info Ops, SoP and SoF. As we have seen in recent years, insurgencies have demonstrated their adeptness at exploiting IED incidents, using global media such as the internet to disseminate their Info Ops messages. Messages of this kind may focus on claims that civilian casualties caused by IEDs intended to target alliance forces are the responsibility of those forces, or that the incident itself was caused by, for example, a misdirected air strike. They therefore constitute a strategic issue, and as well as seeking to defeat the IED threat by attacking

supporting networks, NATO commanders also need to consider the strategic implications of perceptions in those Nations contributing to an alliance.

4.3.9.1 Info Ops. At the operational level, the full range of activities that sit within, or are coordinated by, an overarching Info Ops plan can be supported by A&S Power in the interests of counter-network operations. As well as EW, CIMIC and KLE, these activities may include Command and Control (C2) warfare, Psychological Operations (PsyOps), Presence, Posture, Profile (PPP), Public Affairs and Computer Network Operations (CNO). In supporting them, NATO Air Power can provide a degree of speed, range and agility not available from other environments, offering the prospect of pre-empting an adversary's Info Ops effort and providing a means of delivering effects that are consistent and persistent.

4.3.9.2 SoP and SoF. SoP and SoF activity can serve to disrupt IED emplacement (consistent with the 'prevent' KOA described in Chapter III), as well as reassuring friendly forces and the civilian population. However, as noted above, without a clear understanding of how these techniques are perceived by their target audiences, particularly local civilians, their effects may be neither consistent nor enduring. Again, useful, reliable MoE are often elusive, and it is at least possible that in specific scenarios SoP and SoF may in reality be partly or wholly counter-productive.

4.3.10 Kinetic Effects. Fundamentally, kinetic effects delivered from the air against nodes within an IED network share many of the same characteristics and limitations of those intended to destroy or disrupt emplaced IEDs. Furthermore, the weapon systems used will depend on the type of node being prosecuted as a target, which could include manufacturing or storage facilities, an adversary's LoCs and staging locations, communications nodes, training, leadership, and supporting infrastructure. Given the challenges of identifying IED networks, whether from airborne and Space-based intelligence collection capabilities or from the ground, and accepting the need to ensure that whatever the nature of the node its relevance to C-IED has been established, further considerations also apply. Foremost amongst these is the need to understand how kinetic targeting of network nodes is perceived, both by those against whose interests it is directed and in the wider population. While MoE may on the face of it appear less problematical where kinetic effects are concerned,

A&S Capabilities	Key Operational Activities (KOAs)					
	Predict	**Prevent**	**Detect**	**Neutralise**	**Mitigate**	**Exploit**
Fixed-Wing (FW)		■	■	■	■	
Rotary-Wing (RW)		■		■	■	■
Air Mobility		■			■	■
Space-based ISR	■	■	■			
Airborne ISR	■	■	■			
Non-kinetic effects/ Influence Activity (IA)	■	■		■		■
Electronic Warfare (EW)		■	■	■	■	
Kinetic effects		■		■	■	
UAV	■	■	■			

Figure 5 – Defeating the System – A&S Capabilities and KOAs.

the second-order effects of, for example an air strike on an IED manufacturing facility, will nevertheless need to be considered, with Info Ops coordinating an assessment of the potential costs and benefits of such action.

4.3.11 Defeating the System – A&S Capabilities and KOAs. As with the use of NATO A&S Power in defeating emplaced IEDs, a tabular comparison of A&S capabilities in the counter-network role and the six KOAs set out in Chapter III can be used to underline the overall contribution made by each of the broad capability areas. A schematic, with A&S capabilities relevant to specific KOAs shaded, is at Figure 5.

1. NTISR is also referred to as Armed Overwatch.
2. Also referred to as Aerial Delivery.
3. Although strictly-speaking a counter-network effect, this underlines the limitations of C-IED definitions when set against real-world factors, and though difficult to assess in terms of MoE, there is little doubt that it makes a contribution to C-IED effort.
4. NATO Industrial Advisory Group (NIAG) SG128 Study on Airborne C-IED, NIAG-D (2009)0018 dated 10 September 2009.
5. Trials of Boeing Laser Avenger system reported by UPI in December 2009.

CHAPTER V

Education and Training (E&T) Considerations

5.1 General

The roles of A&S Power in pursuing the first two of the three concurrent strategies identified (*Defeat the Device* and *Defeat the System*) are considered consecutively in Chapter IV of this Primer. The third, *E&T*, both pervades every aspect of the A&S contribution and is crucial to the individual success of each of the capabilities identified, and so warrants separate consideration in this Chapter. The importance of coherent, consistent, comprehensive and, crucially, targeted C-IED E&T has been highlighted elsewhere and, in A&S Power terms, includes a wide variety of roles, from information manager, imagery analyst, communications specialist and EWO, to FAC, JTAC, aircrew and senior leadership. In essence, all those individuals who contribute individually to the delivery of an effect need to understand both the overall process to which they are contributing and be capable of fulfilling their own role within that process. At the same time, those who are seeking to exploit C-IED capability need to understand what assets may be available to them and how to access and use them optimally. It is clear from this that a number of different target audiences for E&T can be identified and which allow training effort to be properly directed. Three key categories for C-IED E&T, considered further in the following paragraphs, are:

5.1.1 E&T to enable land commanders at all levels to fully exploit the A&S Power C-IED capabilities available to them;

5.1.2 E&T for individuals whose roles are primarily C-IED-related or include aspects of C-IED or C-IED support;

5.1.3 E&T for those individuals needing a generic awareness of C-IED principles and practice.

It is essential that land commanders know what A&S C-IED capabilities are available to them.

5.2 Land Commanders

To a great extent, the success of the C-IED contribution made by A&S Power depends on those seeking support having as clear an understanding as possible of the capabilities at their disposal. They therefore need to know what assets are available, how and when to access them, and the real-world limitations of their use – including in terms of speed of response and conflicting requests for tasking. Most importantly, when seeking ISR capability, commanders at all levels need to have an understanding of what actionable intelligence is likely to result. In this respect, it is vital that their training allows them to consider the effect that they are seeking to achieve rather than identifying the most obvious means of achieving it. For example, while the use of a dedicated unmanned air platform may suggest itself as the best means of providing persistent Overwatch along a specified LoC, the sensing capability of the UAV may not be optimised for the type – or types – of IED most likely to be encountered. More relevant and comprehensive, albeit less persistent, sensing capability may be available from another platform or a range of platforms. Similarly, whereas a fast jet may be less able than a dedicated ISR platform to identify emplaced IEDs, the latter is less likely to be in a position to disrupt or seek to destroy such a device, once identified, than would a fast jet conducting Armed Overwatch. Such considerations need to be borne in mind by land commanders at all levels, which in turn requires relevant E&T.

Host Nation E&T constitutes a key element in the C-IED effort.

5.3 C-IED Support Personnel

A large number of personnel undertake specialist roles that directly support the A&S contribution to C-IED operations, and that require those filling them to possess the training, currency and competence necessary to exploit the available resources. These roles include specific C-IED-related posts, for example in deployed headquarters, as well as those that support, but are not exclusively focused on, C-IED. Among the latter are RW and fast jet aircrew who may contribute to airborne NTISR capability, EW operators and analysts, IMINT analysts, FACs and JTACs. Worth noting in particular is the overall benefit to be gained from the appropriate E&T of specialist personnel increasingly filling C-IED-related roles within land formations. The primary purpose of these personnel is to support land formations by providing commanders with advice on the intelligence and other products potentially available to them. In particular, they should be able to understand: the C-IED support requirements from the point of view of the land commander; the means through which these requirements are incorporated into the planning process within the land

formation; how this is effected in Joint planning terms; and the degree of urgency. As with all such digital appointments within formed units, the successful delivery of specialist C-IED support will depend to a considerable extent on the credibility and trust they manage to achieve; this will often be based on practical and socio-cultural considerations such as their integration into the pre-deployment collective training process.

5.4 Generic C-IED E&T Requirements

Consideration of the full range of generic C-IED E&T requirements is beyond the scope of a Primer whose purpose is directed at the A&S Power contribution, albeit within the overall context of the Joint C-IED effort. Nevertheless, many of the Joint generic C-IED E&T requirements apply equally in the A&S domain. Foremost amongst these are to ensure that current NATO C-IED policy and procedures are reflected in the E&T delivered to personnel both at the national level and within an alliance, and that the E&T provided by those Nations supporting an alliance conforms to a common standard. E&T should both be reviewed regularly, reflecting the dynamic, constantly evolving nature of the IED threat and, correspondingly, the C-IED effort to defeat it. These regular reviews should be informed by intelligence on an adversary's TTPs, itself coordinated from a wide range of national and multinational agencies.

5.5 Host Nation C-IED E&T Requirements

The E&T audiences so far identified comprise personnel supporting or seeking to utilise C-IED capability from within NATO alliance partners. A fourth training audience which is usually represented in contemporary operations and which falls firmly within the E&T strategy is that represented by the Host Nation. Not only do Host Nation forces (and the civilian population) often confront the IED threat to the same extent as alliance personnel but, as we have seen in Chapter I, in an insurgency often bear the brunt of IED use. As well as the immediate benefits of providing C-IED E&T to Host Nation forces – not least in reducing casualties and providing local populations with an Info Ops message that supports overall campaign aims, such an approach may also serve longer-term COIN aims and form an element of an alliance exit strategy.

CHAPTER VI

Technological Developments and Future Prospects

6.1 General

Considerable effort and resources have been devoted in recent years to attempting to identify potential technological developments that may assist in the defeat of both emplaced IEDs and the networks that produce them and support their use. It has, however, become increasingly clear that technological solutions in isolation are unlikely to provide the definitive defeat of an adversary determined to continue to employ IEDs, either as the primary means of pursuing his aims or in conjunction with other weapon systems and TTPs. Rather, it is by gaining an understanding of the potential exploitation of existing sensing, disrupting and destructive capabilities and their supporting systems, individually and together, that technology currently stands to make the fullest contribution. Accordingly, the importance of matching the available A&S technology to the specific requirements of a task or operation should not be underestimated. While no single system or combination of sensors and platforms can provide optimal C-IED utility in all circumstances, they collectively contribute to a fused intelligence picture that provides sufficient confidence for commanders to base their decisions on it.

6.1.1 Balancing Current and Future Technologies. A more holistic approach of this kind has now been adopted by agencies, many having previously focused effort on a diverse variety of mainly technological solutions to the IED threat. Such an approach nevertheless includes pursuing innovative technologies, as well as seeking to better utilise those already fielded, and the following paragraphs consider the scope, opportunities and limitations of sensing and other technologies from the A&S perspective, identifying a number of emerging technological trends which currently show promise.

The importance of matching the available A&S technology to the specific C-IED task should not be underestimated.

6.2 Counter-IED Technological Developments

As we have seen, the principle activities capable of being conducted by A&S assets in seeking to defeat the device are those associated with detecting emplaced devices and with neutralising them or mitigating their effects.

6.2.1 Detection – the Silver Bullet. In terms of detection, the allure of a 'silver bullet', a single technological innovation that offers the potential to allow the reliable, repeatable detection of emplaced IEDs, continues to influence efforts in this area. To date, the variety of IED types, their design, the nature of their main charge, their means of initiation and mode of deployment, together with the ability of those using them to constantly vary their TTPs, all serve to reinforce the perception that no such silver bullet is in prospect, and that even if it did emerge and prove successful, an adversary would simply turn to alternative means of pursuing his desired end state. Given that no single technology is yet capable of detecting all possible types of IED or their employment, developments in such areas as laser-induced breakdown spectroscopy, hyper-spectral imaging and bio-molecular sensing capabilities all demonstrate potential, though again caution needs to be exercised when technological demonstrators embark on the process of real-world operationalisation and field trialling. This is also true of increasingly sophisticated CCD software algorithms and ground penetrating and scintillating radars, all of which offer the prospect of being mounted on airborne platforms, and of significantly enhancing NATO's ability to detect emplaced IEDs.[1]

6.2.2 Disruption and Destruction. The ability of airborne platforms to disrupt and destroy emplaced IEDs remotely stands to benefit from a number of technological innovations derived from existing applications. These include the combination on single platforms of multiple sensors able to detect IEDs and the means of attacking them. Engaging IEDs using conventional kinetic means can be effective in this context, and work is in hand to establish the potential utility of high power radio frequency transmissions, high power microwave technology and DEW; the latter have been trialled successfully against a variety of IED types and in a wide range of 'battlefield conditions', and it is probable that such a system could be mounted on airborne platforms. Where the requirement to exploit detected IEDs is paramount, the use of innovative approaches such as water guns and fluorescent dye marking may prove fruitful. With many of these approaches, a particular challenge is presented by the need for an effective, lightweight, durable high-output electrical system to supply sufficient power to sustain multiple sensors and other systems, particularly when UAV-mounted.

6.3 Technology and Counter-Network Capability

As described in Chapter IV, IED networks can be envisioned as containing three recurring phases: resource and plan; execute; and exploit. From the perspective of innovative technological solutions, the resource/plan and exploit phases fall broadly within the capabilities of proven airborne and Space-based ISR capabilities. For example, existing ISR sensors are in principle able to locate, identify and track personnel, installations, facilities and other nodes within the IED network, and although these nodes may serve both the IED network and broader activity associated with an adversary's pursuit of his goals, the use of detailed analysis capability and the fusing of multiple sources of intelligence can achieve specific counter-IED network effects. Similarly, existing airborne EW capabilities stand to be effective against the sort of activities taking place within these phases, including the final assembly of IEDs, their movement and emplacement, and their monitoring by an adversary in advance of their use. It is therefore probable that technological innovations in A&S C-IED capability will support efforts to detect and defeat IEDs in the execute phase, with counter-network activities benefitting from the enhancements, in terms of cueing of capabilities and fusing of intelligence, gained from the better use of existing A&S capabilities.

1. Jane's Defence Weekly, volume 47, issue 34, dated 25 August 2010 contains a comprehensive review of recent developments in A&S IED detection technology.

CHAPTER VII

Points for Consideration

7.1 General

Throughout this Primer, issues, factors and considerations have been identified as influencing the contribution made by A&S capabilities in C-IED operations. Those considered to warrant highlighting are reiterated in this Chapter in order to provide cross-referencing that may be useful to those currently involved in C-IED activities. They may also facilitate the production of checklists, for example:

- Reliable MoE are in place which accurately describe how IA, such as SoF and SoP, affects the target audience (Paragraph 3.2.3);
- ISR assets are included early in the C-IED mission planning process (Paragraph 3.2.5.1);
- Control of A&S assets is pushed to the lowest possible level to enhance early coordination and planning processes, and to ensure ground commanders that they will get the A&S assets they need for their C-IED missions (Paragraph 3.2.5.2);
- Swift, reliable feedback loops inform A&S personnel (aircrew, analysts and so on) about the accuracy of their products, such as feedback on reports of potential IED locations reported by aircrew or viewed in imagery by analysts (Paragraph 3.2.5.3).

7.2 Key Points

The following key points include those issues, factors and considerations that may be of relevance to readers:

7.2.1 C-IED is fundamentally a Joint activity, with A&S Power contributing to the overall effort and intended effect (Paragraph 3.1.1);

7.2.2 In a COIN scenario, the A&S contribution to C-IED represents one aspect of its broader role, and decisions on apportionment should be made on the basis of both the intended impact on the broader COIN campaign and the potential effect on C-IED operations (Paragraph 3.2.3);

7.2.3 Those personnel responsible for the allocation of particular A&S assets, including ISR, should be included as early as possible in the process of planning Joint C-IED operations (Paragraph 3.2.5.1);

7.2.4 The allocation of A&S C-IED capabilities to the lowest level of command for a finite period may provide commanders with the greatest degree of control over those capabilities and the ability to maximise their utility (Paragraph 3.2.5.2);

7.2.5 Exploitation of A&S Power in a C-IED role relies on the processes, organisational structures and networks that support it for planning, coordinating, executing, analysing, assessing and disseminating the required effects (Paragraph 3.2.5), with robust, swift feedback loops being a key feature (Paragraph 3.2.5.3);

7.2.6 Processes supporting the A&S contribution to C-IED should be as free as possible from avoidable constraints and must be fully utilised (Paragraph 3.2.5.4);

7.2.7 A&S C-IED capability tends to support efforts to detect and defeat IEDs in the execute phase of the generic IED network, with counter-network activities benefitting from the enhancements, in terms of cueing of capabilities and fusing of intelligence, gained from the better use of existing A&S capabilities (Paragraph 6.3).

7.3 Defeating the Device

7.3.1 Enhancements in sensors and their combination in MSI configurations, allied to layering of ISR capability, are crucial to successful airborne ISR-delivered C-IED (Paragraph 4.2.3).

7.3.2 The provision of a 'plug and play' approach, allowing multiple sensors capable of detecting different IED types to be utilised and exchanged on single airborne platforms, will contribute to successful detection, including from UAVs (Paragraph 4.2.3).

7.3.3 In addition to its own ISR contribution, Space platforms may also support C-IED operations by

facilitating the rapid passage of warnings from Space-based, airborne or ground-based ISR capabilities to personnel on the ground (Paragraph 4.2.4).

7.3.4 E&T and robust, agile, well-understood processes are needed if the maximum benefit is to be gained from Space-based C-IED capabilities (Paragraph 4.2.4).

7.3.5 NTISR contributes to counter-device operations both in its ability (supported by effective cueing) to detect emplaced IEDs and by delivering a deterrent or disruptive effect (Paragraph 4.2.5).

7.3.6 Three key factors influencing the success of airborne and Space-based ISR in the detection of emplaced IEDs are timeliness, persistence and training (Paragraph 4.2.6).

7.3.7 Air Mobility can serve to neutralise the threat from emplaced IEDs, can re-establish a degree of SA for ground forces (Paragraph 4.2.7.3), and can provide a key capability in its ability to support C-IED exploitation operations (Paragraph 4.2.7.3).

7.4 Defeating the System

7.4.1 Key attributes of airborne ISR and NTISR platforms and sensors in conducting counter-network operations are agility, speed, reach and persistence (Paragraph 4.3.5).

7.4.2 While the utility of airborne NTISR in counter-network operations is more limited than that of specialist ISR capabilities, the combination of E&T and experience can deliver successful change detection capability (Paragraph 4.3.5).

7.4.3 Space-based sensing capabilities can successfully identify network nodes through a variety of indicators: sufficient well-trained analysis capability and useful MoE are nevertheless necessary if the data collected is to be fully utilised (Paragraph 4.3.5).

7.4.4 Considerable effort may be required in order to ensure that access to Space-derived counter-IED network products is available to those that require them, including through the provision of relevant E&T (Paragraph 4.3.5).

7.4.5 Airborne EW capability, used in conjunction with other capabilities and coordinated within a comprehensive Info Ops plan, can make a significant contribution to the disruption of IED networks. (Paragraph 4.3.7).

7.4.6 Air Mobility allows the rapid movement of those capabilities and personnel required for counter-IED network operations, in order that action can be taken against individual or collective nodes that may themselves appear physically remote from the emplaced IED, but which contribute to the overall IED campaign (Paragraph 4.3.8).

7.4.7 A&S Power can provide a degree of speed, range and agility not available from other environments, offering the prospect of pre-empting an adversary's Info Ops effort and providing a means of delivering Info Ops effects that are consistent and persistent (Paragraph 4.3.9.1).

7.4.8 SoF and SoP have a contribution to make to counter-network operations, and their success will partly depend on developing MoE on the perceptions of their various target audiences (Paragraph 4.3.9.2); the same will apply in local perceptions of the kinetic targeting of network nodes (Paragraph 4.3.10).

7.5 Education and Training (E&T)

7.5.1 The success of the C-IED contribution made by A&S Power depends on those seeking A&S capabilities having as clear an understanding as possible of those capabilities at their disposal, including what assets are available, how and when to access them, and the limitations of their use (Paragraph 5.2).

7.5.2 It is essential that personnel undertaking specialist roles that directly support the A&S contribution to C-IED operations possess the training, currency and competence necessary to exploit the available resources (Paragraph 5.3).

7.5.3 Existing NATO C-IED policy and procedures must be reflected in the E&T provided to personnel both at the national level and within an alliance, and the E&T provided by those Nations supporting an alliance should conform to a common standard and is reviewed regularly (Paragraph 5.4).

7.5.4 The delivery of C-IED E&T to Host Nation forces serves to reduce casualties and can contribute to longer-term campaign aims (Paragraph 5.5).

7.6 Technological Developments

7.6.1 Technological solutions in isolation are unlikely to provide the definitive defeat of an IED threat (Paragraph 6.1).

7.6.2 While no single system or combination of sensors and platforms can provide optimal C-IED utility in all circumstances, they contribute to a fused intelligence picture on which commanders can base their decisions (Paragraph 6.1).

7.6.3 The variety of IED types, together with the ability of those using them to constantly vary their TTPs, suggests that no single technological innovation (the 'silver bullet') is likely to offer the reliable, repeatable detection of emplaced IEDs. (Paragraph 6.2.1).

ANNEX A

Acronyms

ANSF	Afghan National Security Forces
ARM	Afghanistan Rights Monitor
A&S	Air and Space
ATO	Air Tasking Order
CCD	Coherent Change Detection
C-IED	Counter-Improvised Explosive Device
CIMIC	Civil-Military Cooperation
COA	Course of Action
CoE	(NATO-accredited) Centre of Excellence
COIN	Counter-Insurgency
CNO	Computer Network Operations
CP	Contact Point
CWIED	Command Wire Improvised Explosive Device
DEW	Directed Energy Weapons
EA	Electronic Attack
ECM	Electronic Countermeasures
EO	Electro-Optical
E&T	Education and Training
EU	European Union
EW	Electronic Warfare
EWO	Electronic Warfare Officer
FAC	Forward Air Controller
FoM	Freedom of Manoeuvre
FW	Fixed-Wing
HLS	Helicopter Landing Site
HME	Home-Made Explosive(s)
HUMINT	Human Intelligence
IA	Influence Activity
IDF	Indirect Fire
IED	Improvised Explosive Device
IMINT	Imagery Intelligence
Info Ops	Information Operations
IR	Infrared
ISAF	International Security and Assistance Force
ISR	Intelligence, Surveillance and Reconnaissance
JAPCC	Joint Air Power Competence Centre
JIEDDO	(US) Joint Improvised Explosive Device Defeat Organisation
JTAC	Joint Terminal Attack Controller
KLE	Key Leader Engagement
KOA	Key Operational Activity
LoC	Line(s) of Communication
MoE	Measure(s) of Effectiveness
MSI	Multi-Sensor ISR

NTISR	Non-Traditional ISR
PPP	Presence, Posture, Profile
PsyOps	Psychological Operations
RCIED	Radio-Controlled Improvised Explosive Device
RW	Rotary-Wing
SA	Situational Awareness
SAR	Synthetic Aperture Radar
SIGINT	Signals Intelligence
SME	Subject Matter Expert(ise)
SOF	Special Operations Forces
SoF	Show(s) of Force
SoP	Show(s) of Presence
TF	Task Force
TLZ	Tactical Landing Zone
TTP	Tactics, Techniques and Procedures
UAV	Unmanned Aerial Vehicle
VOIED	Victim-Operated Improvised Explosive Device

Joint Air Power Competence Centre

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